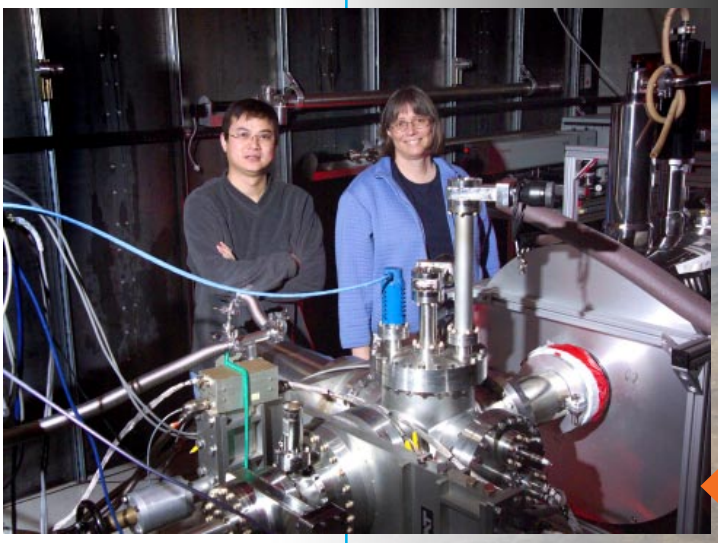

INL is working on a new chemical guidebook that will help Mars rovers search for signs of alien life.

Supporting Space Exploration

INL's space science contributions span decades

Idaho National Laboratory's current support of NASA through its work on final assembly and testing of radioisotope power systems used in deep space probes builds on a long research and development history between the two organizations.

As early as the 1960s, research was performed in Idaho on the Systems for Nuclear Auxiliary Power or SNAP projects. These tests showed the newly organized NASA what it needed to know about the plausibility of using small space reactors in select missions. Tests on the three SNAP reactors concluded in 1966. Beyond such nuclear power research, work in support of the nation's space agency has involved many other science and engineering disciplines over the years.

Astrobiology

To help a NASA rover eventually hunt for life on Mars, INL scientists and their regional colleagues have begun writing a chemical guidebook. Using new imaging tools and earthly parallels of ancient Mars environments, they're recording the types of subtle chemical changes that Martian microbes may have left on the planet's rocks. The researchers hope someday to arm a Mars rover with a suite of tools – a guidebook, precise chemical imagers, and human-like reasoning ability – and let it search for signs of alien life on its own.

Scientists from the U.S. Department of Energy's Idaho National Laboratory, University of Idaho, and University of Montana came together to collaborate on the chemical guidebook as part of what they hope will be a definitive method to determine whether extraterrestrial rocks have ever harbored life. The group, supported by a

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Idaho National Laboratory

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grant from the NASA Astrobiology Program, will be using chemical imaging technology that was previously developed at the INL and awarded a patent in November 2004.

Two sophisticated research tools will aid in building the chemical guidebook. The patented Laser and Optical Chemical Imager (LOCI) combines a laser positioning system with a device known as a Fourier-transform mass spectrometer. The LOCI's laser can blast a rock's surface and lift off a very thin top layer of material as a small gas cloud. Sensors then create spectral images of the cloud, and scientists can decide what the surface layers were made of – minerals rich in iron, say, with a sprinkling of microbial waste products. To help make these decisions, a fuzzy logic computer program called the Spectral IDentification Inference Engine (SIDIE) would supply the Mars rover with some extra brains. The SIDIE, developed at INL, uses an open-ended reasoning approach that mimics a human's decision-making abilities and learning.

Materials Science

In the late 1980s, scientists at Idaho's national laboratory worked to demonstrate the potential for using acoustic vibration patterns to inspect the thermal protection tiles used on the space shuttle fleet. The research, conducted for the Kennedy Space Center, sought to develop a nondestructive testing technology that would allow for the examination of heat shield components following shuttle flights to identify loose or damaged tiles.

Because of the complex nature of the tiles and the multilayered geometry of the tile-strain isolation pad system, conventional nondestructive examination techniques, such as x-ray and ultrasound, didn't prove feasible.

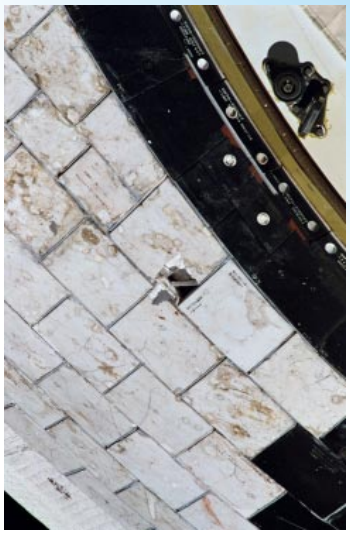
The noncontacting laser inspection technique developed for NASA involved the use of acoustic waves to cause small vibrations on a tile. These vibrations are then sensed by a laser beam that is focused on the tile's surface. The very small amount of light reflected from the tile is used to derive a signal that follows the surface displacement. A portable computer then collects and analyzes the signals to detect variations in the tile's vibrational response to identify any abnormal conditions.

Human-System Simulation

Human error remains a dominant contributor to accidents. The FRANCIE (Framework Assessing Notorious Contributing Influences for Error) project for NASA was undertaken in 2000-2001 to continue development of a new approach to analysis, prediction, and characterization of critical human errors. The approach was based on years of experience at INL in applying, refining, and developing human error analysis methods, plus input and support from industry, academic and government partners.

In spring 2003, two representatives from INL traveled to the Johnson Space Center in Houston where they assisted the Columbia Accident Investigation Team. INL scientists assisted in building a detailed master logic diagram using SAPHIRE, a risk assessment software program INL developed for use by the U.S. Nuclear Regulatory Commission and NASA. INL assisted NASA with a numbering scheme to provide a reference system so engineers and managers could readily identify and track the status of possible accident initiating events and causes.

The FRANCIE project and others like it were performed for NASA by Idaho scientists and engineers because INL houses the largest group of human factors, operations and systems analysis professionals in the DOE complex. The laboratory has a well-established reputation in technology, risk assessment, and evaluations of human performance in complex, close-tolerance industries.



INL scientists helped develop technology to inspect the thermal protection tiles used on space shuttles (right), and a new approach to analysis, prediction, and characterization of human errors (far right).

For More Information

800-708-2680
www.inl.gov

INL is one of the U.S. Department of Energy's multiprogram national laboratories and is managed by Battelle Energy Alliance, LLC.